



# The New Normal

# I'm in It for the Long Haul: Anesthetic Implications of Elective Surgery in the COVID-Recovered Patient

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**T**he COVID-19 global pandemic led to a complete halt in elective surgery so that hospitals could conserve their resources for the onslaught of critically ill patients. Now, as the rate of new infections that require hospitalization declines in the wake of vaccination, new discussions center around how to restart scheduling surgeries.

ASA and the Anesthesia Patient Safety Foundation (APSF) have created a joint statement outlining recommendations on when to proceed with elective surgery in the era of COVID-19. According to these guidelines, it would be reasonable to begin scheduling elective surgeries once the incidence of COVID-19 positive infection rates had been declining for 14 days in conjunction with availability of an appropriate number of available ICU and non-ICU beds and of sufficient personal protective equipment (PPE) (asamonitor.pub/3osobsn).

### To isolate or not to isolate... that is the question

The APSF states that, unequivocally, all patients presenting for elective surgery should be tested for COVID-19 (asamonitor.pub/31CaA9P; asamonitor.pub/3BZ889Q). If patients refuse testing, a 10-day period should elapse wherein the patient is completely asymptomatic prior to the procedure and clinicians should implement full precautions in the OR as if the patient were shedding the virus (asamonitor.pub/31CaA9P). If a patient tests positive, it is recommended to wait at least 10 days after symptom onset in mild cases and 15 days after symptom onset in severe cases to lift isolation precautions. Complete symptom resolution and 24 hours of absence of fever without antipyretics are essential prerequisites.

### Wait times for elective surgery and repeat testing

Table 1 elaborates recommended wait times for patients after COVID-19 infection. At present, the CDC does not recommend re-testing for COVID-19 within 90 days of symptom onset. In fact, repeat



Long haul COVID and the lung



Cardiovascular dysfunction after COVID



COVID and the brain



Fibromyalgia and COVID

PCR testing in asymptomatic patients is ill advised since persistent or recurrent positive PCR tests are common after recovery while not indicating infectivity. However, if a previously asymptomatic patient presents with new symptoms within 90 days, testing may be indicated (asamonitor.pub/3osobsn). If a patient has a positive result from a standard RT-PCR test, a strand-specific test can be considered. Since the SARS-CoV-2 virus is a single strand RNA virus, a test that specifically detects the negative strand in a patient sample indicates active replication and infectivity rather than contamination from nasal mucosa.

### What if the patient has residual symptoms?

While symptom relief is a crucial factor in timing surgery, the guidelines also note that symptoms such as shortness of breath or chest pain can be present more than 60 days after initial diagnosis (asamonitor.pub/3osobsn). In one study by Frija-Masson et al., 50% of patients

with COVID-19 pneumonia continued to exhibit abnormal lung function 30 days after symptom onset that was concerning for progression to fibrosis (*Eur Respir J* 2020;56:2001754). A recent GlobalSurg-COVIDSurg multicenter cohort study demonstrated that following a seven-week delay between infection and surgery, patients with ongoing symptoms had a significantly higher mortality rate than patients whose symptoms had completely resolved and, therefore, these patients may benefit from further delay (*Anaesthesia* 2021;76:748-58).

### So let's talk about the long haul...

Huang et al. demonstrated that more than 50% of patients with COVID-19 had ongoing symptoms several months after discharge from the hospital (*Lancet* 2021;397:220-32). Similar results were reported by Carfi et al. who evaluated patients 60 days after discharge from hospitals in Italy (*JAMA* 2020;324:603-5). Post-COVID conditions have been referred to by a wide range of



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terms, including long haul COVID, post-acute COVID syndrome, chronic COVID, and the research acronym PASC (post-acute sequelae of SARS-CoV-2 infection). The CDC defines post-COVID conditions as an umbrella term encompassing the variety of health consequences that may be present four or more weeks following infection, including persistent pulmonary symptoms such as cough, dyspnea, fatigue, poor endurance, syncope, paresthesia, mood changes or cognitive impairment, and generally impaired daily function. While many organs were affected, chronic malaise, pulmonary symptoms, cognitive impairment, and autonomic symptoms were the most prevalent.

### Long haul COVID and the lung

A significant proportion of patients have persistent pulmonary dysfunction with radiographic abnormalities and impaired lung diffusion noted on pulmonary function tests. In particular, patients who required high-flow nasal cannula, non-invasive ventilation, or mechanical ventilation during hospitalization had higher rates of ground glass opacities and fibrotic changes noted on computed tomography scans, suggesting persistent interstitial

Table 1: ASA-APSF recommended wait times for elective patients in the COVID recovered	
Clinical symptom severity	Recommended wait time for elective surgery
Asymptomatic patient or patient with mild non-respiratory symptoms.	4 weeks
Patient with mild respiratory symptoms who did not get hospitalized.	6 weeks
Symptomatic patient who is diabetic, immunocompromised, or hospitalized.	8-10 weeks
Patient who was admitted to an ICU due to COVID-19 infection.	12 weeks

lung disease. However, the relationship between persistent illness and initial disease severity has been called into question (*Ann Am Thorac Soc* 2021;18:997-1003). A systematic review and meta-analysis by Torres-Castro et al. aimed to describe the prevalence of persistent lung dysfunction in patients who had been diagnosed with COVID-19 (*Pulmonology* 2021;27:328-37). COVID-19 can cause diffuse alveolar epithelium destruction, hyaline membrane formation, capillary damage, proliferation of alveolar septal fibrous material, and pulmonary consolidation in patients post-infection (asamonitor.pub/303SFIq). They

**“Given that the resolution of COVID symptoms is highly variable depending on illness severity and pre-existing comorbidities, preoperative testing and the decision to proceed with surgery in patients with persistent symptoms should involve a multidisciplinary discussion that includes anesthesiologists, surgeons, and the relevant internal medicine specialists.”**

found that 39% of patients had altered diffusion capacity, 15% of patients had a restrictive pattern of pulmonary function, and 7% had an obstructive pattern when evaluated within several months of infection when neither was present prior to infection (*Pulmonology* 2021;27:328-37). This has important implications for anesthetic management since we know that patients with obstructive pulmonary disease have increased morbidity under general endotracheal anesthesia (*Indian J Anaesth* 2015;59:574-83). These patients are more prone to intraoperative events such as bronchospasm, auto-PEEP, and decreased FRC, which limits their reserve. They are also more susceptible to postoperative complications such as hypoxia, bronchopneumonia, atelectasis, need for ventilator support, and bronchitis (asamonitor.pub/303SFIq). The recommendation for patients with severe COPD is to avoid endotracheal intubation

when possible and implement good pain management techniques to avoid splinting postoperatively. These considerations can likely be juxtaposed to COVID-induced long-term pulmonary changes (asamonitor.pub/303SFIq).

### Cardiovascular dysfunction after COVID

The host cell receptor for the COVID-19 virus is the angiotensin converting enzyme (ACE)2, paving the way for cardiac injury in acute COVID infection. While acute infection can present as coronary artery disease, perimyocarditis, and even stress cardiomyopathy, elevated troponin, and abnormal EKG changes may also be present in recovered patients and warrant further cardiovascular testing in the presence of decreased functional capacity or persistent fatigue. A study of patients who developed severe ARDS secondary to COVID-19 in Germany found that many patients had abnormal cardiac MRI findings on follow up; the most prevalent abnormality was myocardial inflammation defined by abnormal native T1 and T2 cells, suggesting acute/subacute perimyocarditis (*JAMA Cardiol* 2020;5:1265-73). Viral-induced inflammation with subsequent hypoxemia and acute respiratory distress syndrome (ARDS) causes cardiac remodeling with right ventricular dilatation, pulmonary hypertension, and left ventricular diastolic dysfunction. Although the long-term health effects and clinical consequences of these findings are indeterminate, a lower threshold for preoperative electrocardiogram (EKG) and/or transthoracic echocardiogram (TTE) may be appropriate in patients with suspected cardiac involvement.

### COVID and the brain

Data suggest that 50%-70% of patients develop neurological symptoms that include headache, dizziness, brain fog, disorientation, vision abnormalities, delirium, and lapses of consciousness after moderate to severe COVID infection (*JAMA* 2021;325:1525-34). Delirium is a common complication during acute COVID infection, with a prevalence of up to 80% in the ICU, and is the presenting symptom of COVID in 30% of older patients. Becker et al. evaluated 740 survivors and demonstrated a statistically significant level of deficits compared to controls when subjected to cognitive tasks testing attention, reasoning, working memory, and emotion processing abilities (*JAMA Netw Open* 2021;4:e2130645). Deficits were more severe in patients who required mechanical ventilation, although patients who never required hospital admission also demonstrated significant global performance deficits. Ragheb et al. also demonstrated that persistent

neuropsychological impairment occurs in patients presenting with COVID-19 delirium (*BMJ Open* 2021;11:e050045). Davis et al. further demonstrated that while delirium may be the presenting symptom, it could be a manifestation of underlying dementia-related processes and may accelerate preexisting cognitive decline (*JAMA Psychiatry* 2017;74:244-51). Preexisting delirium episodes can predispose to post-anesthesia delirium, increasing the perioperative risk and possibly cognitive decline.

While further longitudinal studies incorporating neuroimaging are needed to determine the biological basis of persistent cognitive symptoms, the etiology is likely multifactorial, including systemic inflammation, cerebrovascular effects from hypoxia, post-infectious autoimmune mechanisms, and possible direct CNS effects of the virus. Previous studies on ARDS survivors have shown a high prevalence of cognitive impairment that may persist for up to several years, for which proposed pathophysiological mechanisms have been well described. COVID survivors who required ICU care are expected to have a high prevalence of post-intensive care syndrome (PICS), which encompasses impairments in physical, cognitive, and mental health function after any critical illness. This has to be distinguished from cognitive dysfunction due to long haul COVID, further adding to the conundrum.

### The autonomic side to COVID

Paroxysmal orthostatic tachycardia syndrome (POTS) and orthostatic hypotension are well established as manifestations of long COVID and can have significant perioperative implications. Mechanisms include damage to endothelial cells expressed in the heart, blood vessels, and kidneys due to direct virus binding to ACE2 enzyme in the cells (*Auton Neurosci* 2021;235:102841). POTS can present with sustained hemodynamic instability intraoperatively (*J Clin Anesth* 2011;23:384-92). A thorough preoperative history leading to early diagnosis with proper preconditioning can help prevent this perioperatively.

### Fibromyalgia and COVID

Many of the documented post-COVID sequelae discussed above include diagnostic criteria for fibromyalgia. It is unclear if underlying fibromyalgia is

revealed by COVID or COVID mimics fibromyalgia, as there is confounding pathophysiology. Fibromyalgia patients are known to have increased pain that is often difficult to control after surgery, and this should be kept in mind during the preoperative assessment and considered in planning for postoperative pain management (*Curr Opin Anaesthesiol* 2009;22:627-33). Regional techniques may be a good adjunct/alternative to optimize postoperative pain management.

While guidance exists regarding the optimal timing of elective surgery following recovery from COVID, consensus regarding preoperative testing and optimization of patients with persistent symptoms is less clear. Current guidance from the British Thoracic Society suggests following up with patients who experienced severe pneumonia secondary to COVID-19 requiring ICU level care with an evaluation for the assessment and management of oxygen requirements, psychosocial issues, and consideration of venous thromboembolic disease 12 weeks after discharge. Recommended testing includes chest X-rays, pulmonary function tests, echocardiogram, walk tests to assess oxygen saturation, and high-resolution CT and CT angiogram depending on the presence of persistent CXR changes or ongoing respiratory symptoms (asamonitor.pub/3qv6hrc). If abnormalities in lung function are found in conjunction with abnormal CT imaging, referral should be made to a specialist in interstitial lung disease. This guidance differs distinctly from that of the American Thoracic Society, which has not recommended any routine imaging or testing for patients recovering satisfactorily from community-acquired pneumonia at this time.

Given that the resolution of COVID symptoms is highly variable depending on illness severity and pre-existing comorbidities, preoperative testing and the decision to proceed with surgery in patients with persistent symptoms should involve a multidisciplinary discussion that includes anesthesiologists, surgeons, and the relevant internal medicine specialists. It should be individualized, and proceeding should be weighed against the risks of delaying surgery for time-sensitive conditions. Further work is needed to reach consensus-based recommendations regarding risk stratification, testing, and interventions to reduce perioperative risk in the ever-increasing population of COVID survivors. ■

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